High Energy, Low Temperature Gelled Bi-Propellant Formulation for Long-Duration In-Space Propulsion, Phase I

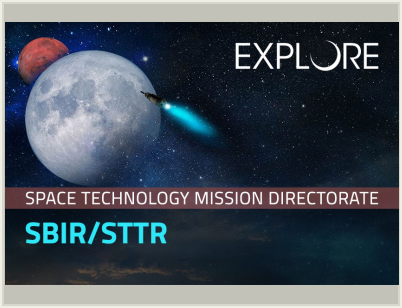
Completed Technology Project (2005 - 2005)

Project Introduction

Development of a candidate bi-propellant system consisting of a gelled hydrocarbon fuel coupled with a highly energetic gelled oxidizer suitable for outer planetary missions is proposed. Theoretical calculations suggest that this innovative combination can meet NASA's propulsion requirements for low power consumption (i.e. minimal use of heaters) while providing a vacuum specific impulse of ~ 360 seconds. Gelling the propellant provides the advantage of higher volumetric efficiency and suspending energetic fine particulates (e.g. boron, carbon, or aluminum) increases the energetic yield. Furthermore, gels do not spread if spilled and have greatly reduced vapor pressure making their handling far less hazardous, compared to current spacecraft fueling procedures that employ highly toxic liquid hypergols. The Phase I program objectives will include the 1) formulation of gel propellant fuel samples, 2) measurement of their rheological properties as a function of temperature, 3) simulation of a gel-fueled thruster propellant flow network using NASA's GFSSP code, and 4) high-fidelity simulations of the gel propellant tank expulsion process at outer planet equilibrium temperatures. The Phase II will include further properties assessments, high-fidelity simulations of the bi-propellant combustion process followed by experimental gel thruster test and evaluation. This innovation will improve the safety, operability reliability, and performance of in-space propulsion systems and extend the existing technology base for human and robotic exploration missions.

Anticipated Benefits

CFDRC's expertise in propulsion controls, controllable bi-propellant engines and working relationships with Northrop Grumman, Boeing, Aerojet, and Alliant TechSystems assures rapid Phase III transition of the Phase I and II results. Many of these companies are interested in high-performance, low temperature bi-propellants for various military applications and commercial application such as: airbag inflators for automobiles, emergency escape systems for aircraft, underwater propulsion, demolition of unwanted structures such as buildings, bridges, towers, etc., and high-performance upper stage and Divert and Attitude Control System (DACS) applications. The proposed low-storage temperature bipropellant MON-30/GLP combination provides NASA the capability to engage in planetary missions with reduced power budgets devoted to propellant warmingand offers singificant improvement in safety operations with high performance. This will enable missions to the outer planets on the more reduced budgets available today and still allow NASA scientists to collect vast amounts of data. This propellant technology will also be applicable for upper stage orbital maneuvering.



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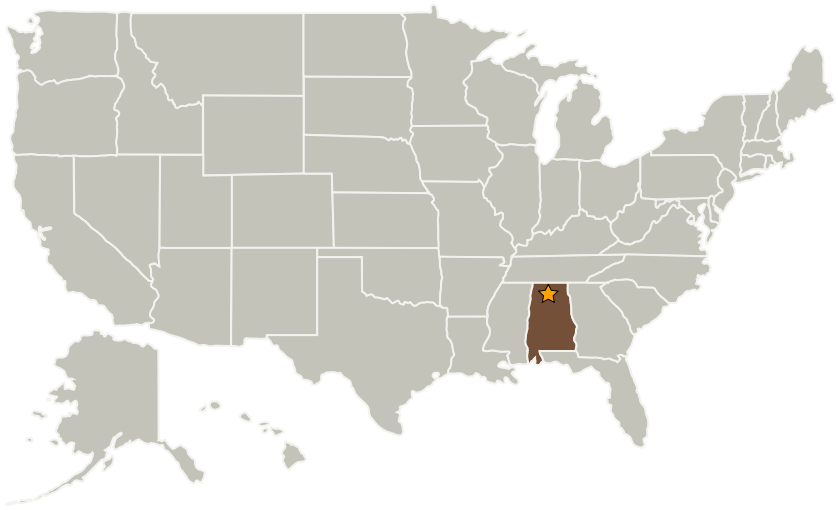
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Marshall Space Flight Center(MSFC)	Lead Organization	NASA Center	Huntsville, Alabama
CFD Research Corporation	Supporting Organization	Industry	Huntsville, Alabama

Primary U.S. Work Locations
Alabama

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Marshall Space Flight Center (MSFC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Project Managers:

Brenda Manuel
John M Price

Principal Investigators:

David S Weaver
Roberto Di Salvo

Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.1 Chemical Space Propulsion
    - TX01.1.6 Gels